Teacher Candidates' Efficacy Beliefs in Mathematics: Play-Generated Curriculum Instruction

Lutfi Incikabi
Kastamonu University, TURKEY

The article starts with the next page.

Teacher Candidates' Efficacy Beliefs in Mathematics: Play-Generated Curriculum Instruction

Lutfi Incikabi
Kastamonu University, TURKEY

The aim of this study was to present changes, if any exist, in early childhood teacher candidates' mathematics teaching efficacy beliefs (MTEB) after the implementation of a play-generated curriculum approach. This experimental one-group pretest-posttest design utilized qualitative data through an open-ended questionnaire conducted at the end of the instruction. Thirty-seven second-year college students from the Early Childhood Education department at Mersin University participated in the study. Among the instruments used during the study were a questionnaire for the participants' demographics, a Turkish version of MTEBI for teacher candidates, an open-ended questionnaire focusing on the difficulties confronted by teacher candidates during the preparation and implementation of a lesson plan utilizing the play-generated curriculum approach and lesson observation form. The results indicate that early childhood education teacher candidates' mathematics teaching efficacy beliefs when combined with their personal mathematics teaching and outcome expectancy beliefs possessed a positive and statistically significant change after they prepared play-based instruction.

Keywords: mathematics education; self-efficacy; early childhood education; play-generated curriculum

INTRODUCTION

Play in early childhood has an essential role in providing both academic and social-enrichment opportunities for young children Ginsburg (2007). According to Johnson, Christie and Yawkey (1999), play-based learning activities offer distinct advantages, such as providing opportunities for the students to construct their own knowledge about mathematics with help from their peers. In addition, among the advantages of linking play and academic subjects are that play develops positive attitudes toward learning since it is fun and enjoyable, that the non-literal nature of play makes academic activities significant to children, that the means are more important than the ends during

play activities, and that play provides a broad spectrum of learning opportunities (Johnson, Christie and Yawkey, 1999).

Students can learn a variety of different skills and concepts in multiple ways associated with play. Moreover, according to Mayesky (2002), creativity is increased through play and exploration. One criticism about the curriculum and its applications is that we expect programs to teach specific outcomes prescribed adult objectives (Kagan & Cohen, 1997) and limit their times for joyful activities such as play (Beauchat, Blame & Walpole, 2010). Especially, mathematics is known as one of the hardest field to teach to young children (Pound, 2008).

Research documenting a relationship between play skills and other areas of development has provided the foundation for a number of studies that have focused on whether adults can teach children to play in such a way that will provide learning benefits for children (Berk, 1994; Mallory & New, 1994). The intervention is typically called play training in Early Childhood Education (ECE) and involves a variety of play

Correspondence to: Lutfi Incikabi, Kastamonu Universitesi, Egitim Fakultesi, İlköğretim Bölümü, Matematik Öğretmenliği; C Blok Kat: 3 No: 3 Merkez/Kastamonu, TURKEY
E-mail: lutfiincikabi@yahoo.com

State of the literature

- Play in early childhood has an essential role in providing both academic and social-enrichment opportunities. Research documenting a relationship between play skills and other areas of development has focused on whether adults can teach children to play in such a way that will provide learning benefits for children.
- Play develops positive attitudes toward mathematics and provides intrinsic motivation. Children's mathematics learning starts with the development and learning of some main concepts during their early childhood years.
- Research related to the teachers' self efficacy beliefs signals a significant relationship between teachers' self-efficacy beliefs and students' academic achievements.

Contribution of this paper to the literature

- This study provides the effects of the play-generated curriculum instruction on teacher candidates' mathematics teaching efficacy beliefs.
- This study presents a consistence with the literature in terms of increased teaching efficacy beliefs of teacher candidates through play-based instruction and classroom teaching.
- Studies conducted on teaching efficacy beliefs in mathematics were specifically limited with elementary teacher candidates. These studies indicated that teacher candidates participating in mathematics teaching courses presented significant gains in teaching efficacy. Similarly, this study presents evidence of the effects of play-generated curriculum approach on pre-service teachers' self-efficacy beliefs while teaching at pre-schools.

enrichment strategies comprised of informal, though purposeful, adult interventions in children's spontaneous play activities (Trawick-Smith, 1998). Studies have shown that play training can enhance play and related areas of development for children (e.g., Enz & Christie, 1993; Levy, Wolfgang, & Koorland, 1992; Vukelich, 1994). Further, providing an early childhood setting in which child-initiated, child-directed, teacher-supported play serves as the primary context in and the major activity through which young children learn is considered to be developmentally appropriate and, thus, a best practice in general ECE (Bredekamp & Copple, 1997).

The relationship between play and curriculum has proposed several connections, including curriculum-generated play and play-generated curriculum (Van Hoorn, Nourot, Scales, & Alward, 1993). In the former,

teachers provide play experiences that can enable children to learn concepts and skills from curriculum areas; in the latter, teachers organize learning experiences around themes and interests that children have demonstrated in their play (Johnson, Christie, & Yawkey, 1999). This study utilized the play-generated curriculum approach since children learn from participating in developmentally appropriate early childhood settings that form a curriculum around play (Hanline, 1999).

Cuffaro (1995) stated that it is more challenging to seek out and use children's interests as the basis for play-generated curriculum than to ask the children to select a play theme. Johnson, Christie and Yawkey (1999) proposed three models for teachers to use in play-generated curriculum activities. The first model, the juxtaposition model, allows teachers take ideas from free play and use them as the basis for follow-up or related activities in adjacent time slots in the daily schedule. The second model, the integration model, lets teachers serve as spokespersons for reality during free play in order to take advantage of teachable moments. The third model, the segregation model, occurs when recreational play, without an attempt to include education, is allowed in the program.

Play develops positive attitudes toward mathematics and provides intrinsic motivation. Children's mathematics learning starts with the development and learning of some main concepts during their early childhood years. Among these concepts are numbers and operations, geometry, measurements, patterns and algebraic thinking, collecting, and analyzing and showing data (National Council for Teachers of Mathematics [NCTM], 2006; National Association for the Education of Young Children [NAEYC], 2008). When engaging in spontaneous play, children can explore a wide range of mathematical ideas and skills (Balfanz, Ginsburg, & Greenes, 2003; Kirova & Bhargava, 2002; Sarama & Clements, 2003). However, Balfanz, Ginsburg and Greenes (2003) have stated that "play is not enough!" and that "children learn through play, but children need adult guidance to reach their full potential" (p. 264).

Self-efficacy steams from Bandura's Social Learning Theory. According to Bandura, self-efficacy is an efficient factor in the formation of behavior (1997). In general, research related to the teachers' self efficacy beliefs has stated that teachers with high self-efficacy beliefs present more desire for teaching, are quick and clear on making important teaching decisions, are more successful and less stressed when applying the curriculum, are open to new teaching strategies and ideas, and are less critical toward students when they make a mistake (Gibson & Dembo, 1984; Riggs & Enochs, 1990). Teachers with high self-efficacy beliefs also work harder with struggling students, develop better lesson plans and focus more on students' success

and development (Zengin, 2003). Teachers' self-efficacy perceptions present individual differences in regard to efficiency in teaching. Moreover, a significant relationship has been shown to exist between teachers' self-efficacy beliefs and students' academic achievements (Finney & Schraw, 2003; Pajares,1996; Riggs & Enochs, 1990).

Teacher efficacy, defined as "teachers' beliefs in their ability to actualize the desired outcomes" (Wheatley, 2005, p. 748), has emerged as an important construct in teacher education during the last decade. Bandura (1997) indicated that efficacy beliefs depend upon the situation or context relative to the action or task to be performed. According to Gibson and Dembo (1984),

> teachers who believe [that] student learning can be influenced by effective teaching (outcome *expectancy beliefs) and who also have confidence in their own teaching abilities (self efficacy beliefs) should persist longer, provide a greater academic focus in the classroom, and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student learning (p. 570).*

Although there are many studies concerning teacher efficacy (e.g., Can, Günhan, & Erdal, 2012; Thomson & Kaufmann, 2013), there is limited research on mathematics teacher efficacy, specifically with elementary teacher candidates. Some studies on mathematics teacher efficacy of elementary teacher candidates found that teacher candidates participating in mathematics teaching courses presented significant gains in mathematics teacher efficacy (Cakiroglu, 2000; Huinker & Madison, 1997; Wenta, 2000). Research also provided the factors affecting efficacy beliefs of mathematics teacher candidates. Exposure to reform approaches in a mathematic methods course has been linked to mathematics teaching efficacy (Cakiroglu, 2000). Another factor affecting mathematics teacher candidates' self efficacy was mathematics anxiety (Swars, 2004), that was negatively correlated with teaching efficacy beliefs in mathematics (Swars, Daane, & Giesen, 2006). Swars (2004) reported that mathematics teacher efficacy is associated with instructional strategies as well as past experiences with mathematics. In a longitudinal study that examined pedagogical beliefs, teaching efficacy beliefs, and anxiety of prospective mathematics teachers, Swars, Smith, Smith, and Hart (2009) found that prospective teachers experiencing a developmental two-course mathematics methods sequence and coordinated developmental field placements presented change in their beliefs. After analyzing elementary school teachers' and teacher candidates' mathematics teaching efficacy beliefs, Sahinkaya (2008) found that the outcome expectancy of the candidates was higher than those of the teachers. Isler and Cakiroglu (2009) indicated that Turkish primary teachers had significantly stronger efficacy

beliefs about the new curriculum than the mathematics teachers.

Based upon the literature review, this study aimed to present the changes in the scores of early childhood teacher candidates in terms of their teaching efficacy, self-efficacy and outcome expectancy beliefs following a play-generated curriculum instruction. The research question used for this study is as follows. "Do differences exist in regard to teacher candidates' mathematics teaching efficacy beliefs before and after the play-generated curriculum instruction when one considers the self-efficacy and outcome expectancy dimensions?"

Methodology

This study used an experimental one-group pretest-posttest design. The data from this design was supported by qualitative data gathered using an open-ended questionnaire conducted at the end of the instruction. Johnson and Christensen (2004) define the one-group pretest-posttest design as "administering a posttest to a single group of participants after they have been pretested and given an experimental treatment condition" (p. 276). The authors also state that experimental research is the most reliable tool by which to identify causal relationships as it allows the researcher "to observe, under controlled conditions, the effects of systemically changing one or more variables" (p. 39). In addition, when conducting experimental research, the researcher changes an independent variable and assesses its effect on a dependent variable. Experimental studies are unique as they are "the only type of research that directly attempts to influence a particular variable" (Fraenkel & Wallen, 2000, p. 283). In this study, the teacher candidates' beliefs were used as the dependent variable, while the play-generated curriculum instruction (teaching method) was used as the independent variable.

Sampling Procedure

The participants for this study were second-year students from the Early Childhood Education Department at Mersin University. The researchers applied convenience sampling strategies as the sample of 37 participants was taken from students who registered for the Play Development in Early Childhood course. It is important to note that all of the students voluntarily participated to the study. In addition, the instructor was from the mathematics education field and had completed numerous studies in the areas of curriculum development at early childhood education institutions, early childhood education teachers' mathematics education and early childhood education within the past seven years.

Participants' Background Information

The background information on the students was collected via a demographic questionnaire, which included questions about the students' ages; genders; GPAs; the program types they registered for; whether they had previously participated in lessons focused on play development; whether they taught at or worked in pre-schools or child care centers; if they worked in such places, how long did they work there and whether play or play development lessons took place in these locations.

As part of their assessment for the Play Development in Early Childhood course, 37 second-year college students participated in this study. According to the results from the demographics questionnaire, the students ranged in age from 18 to 24, with an average of 19.7. Their (n=37) average GPA was 3.1 (based on 0-4 scale). Some of the students (n=10) stated that they had previous experience teaching in a early childhood education institution. The average amount of time in which the individuals worked in the pre-school was 11.8 months (range from 4 months to 24 months). None of the other participants had worked in an early childhood education center. Of the participants, only seven had taken lessons related play development. Of these lessons, the majority consisted of inspecting children's development stages and preparing activities to be used to develop the children's skills, such as problem-solving and creativity.

Instrumentation

Four instruments were used to collect data in this study. First, a questionnaire, developed by the researcher, was used to collect data on the students' demographics. A description of the questionnaire was provided earlier.

The second instrument was a Turkish version of Enochs, Smith and Huinker's (2000) "The Mathematics Teaching Efficacy Belief Instrument (MTEBI)" for teacher candidates, translated by Sahinkaya (2008). Gibson and Dembo (1984) developed a "Teacher Efficacy" scale, which was one of the first scale developments to measure a teacher's efficacy and his/her perceptions of self-efficacy. Gibson and Dembo's scale consists of two dimensions: personal teaching efficacy and self-efficacy and outcome expectancy. Riggs and Enochs (1990) modified Gibson and Dembo's instrument to apply to science teachers and renamed it the "Elementary Teacher's Science Teaching Efficacy Belief Instrument." This instrument also included two dimensions: personal science teaching efficacy beliefs and science teaching outcome expectancy.

The MTEBI, presented by Enochs, Smith and Huinker (2000), was created through a modification of Riggs and Enochs' instrument. The MTEBI consists of 21 items: 13 items on the Personal Mathematics Teaching Efficacy (PMTE) subscale and eight items on the Mathematics Teaching Outcome Expectancy (MTOE) subscale. For the PMTE, five items were written in a positive orientation and eight were written in a negative orientation. For the MTOE, all eight items were written in a negative orientation. The negatively orientated items were re-coded for the analysis. Below is a sample of the items in the MTEBI.

- *Self-efficacy: Even if I tried very hard, I would not be able to teach mathematics as well as I teach most other subjects;*
- *Outcome Expectancy: The mathematics achievements of some students cannot, generally, be blamed on their teachers.*

The MTEBI uses a five-point Likert-type scale (5=strongly agree, 4= agree, 3=uncertain, 2=disagree and 1=strongly disagree). Possible scores on the MTEBI scale range from 21 to 105, the PMTE scale ranges from 13 to 65 and the MTOE scores may range from 8 to 40. The reliability analysis produced an alpha coefficient of .88 for the PMTE scale and .75 for the MTOE scale (n = 324). The same instrument was translated into Turkish and applied to the Turkish mathematics teacher candidates studied by Sahinkaya (2008). This study produced an alpha coefficient of .79 for the PMTE scale and .73 for the MTOE scale (n = 150).

The third instrument used was an open-ended questionnaire developed by the researcher in order to discover the answer to:

- *What are the difficulties confronted during the process of preparation and implementation of the lesson plan utilizing play-generated curriculum approach?*
- *What are the advantages or disadvantages of using play-generated curriculum approach?*

The fourth instrument used was the lesson observation form, which was developed by experts in a teaching practice course in which teacher candidates were observed while teaching in a real school environment. The form includes four main parts, namely personality, classroom management, teaching phase, objectives and methodology. Two observers, the instructor and one external expert, evaluated (by providing comments) teacher candidates teaching based on the lesson observation form.

Procedures

While Johnson, Christie and Yawkey (1993) presented three models to be used when teaching teachers play-generated curriculum, only two were used in this study. The first model, the juxtaposition model,

Table 1. Experiment Design

Sessions	Topic	Activities
Session 1	Course Description What is "Play?" Characteristics of Play	Compose groups Discussion around the Definition of play
Session 2	Play Theories	Group presentations on play theories
Sessions 3, 4	Play types	Find a play and categorize it according to its type of play
Sessions 5, 6, 7,8	Selection of play Preparation of a play plan Application of the play plan	Preparation of a play plan (individually). Discussing the plans with group members. Deciding on one to present to the class.
Sessions 9, 10	Inspection of early childhood program: Philosophy of the program Play inclusion in the program Children's developmental requirements Mathematics subjects Mathematical behaviors	Individual submission of mathematics behaviors as defined in the program. Individual submission of mathematics aims/behaviors (as defined in the program) for selected play.
Sessions 11, 12	Teachable moments during free play. How to use play observations for teaching (after play).	Discussions around "teachers' roles in teaching during or after free play."
Sessions 13, 14, 15, 16	Preparation of a play- generated lesson plan (individually) and teaching.	

allows teachers to take ideas from free play and use them as the basis for follow-up or related activities in adjacent time slots in the daily schedule. The second model, the integration model, lets teachers serve as spokespersons for reality during free play in order to try to take advantage of teachable moments. The third model, the segregation model, was not used in this study as it only calls for recreational play without the inclusion of education.

This study took place during a 16 week semester and was made up of several steps (Table 1). During the first session, the participants, teacher candidates, completed demographic data and open-ended questionnaires. Then, they were asked to form eight groups (five groups of five students and three groups of four students) within which to complete future presentations and homework. While within the classroom, the teacher candidates discussed the definition and characteristics of (free) play. These characteristics are clarified at the end of this section.

The second session included a presentation on the theories of play. Working in groups, the teacher candidates were asked to prepare a presentation on classical and modern theories of play. The next two sessions focused on play types, and the teacher candidates, working in groups, were asked to bring a play (free play) related to mathematics in and present its characteristics, including type, to the class. In the next four sessions, the teacher candidates were instructed as to how to select the appropriate play related mathematics activity, create a plan on how to use the activity and apply that plan within the classroom.

Toward the end of the course, the teacher candidates were asked to individually prepare a play plan and then, working in groups, choose the plan they thought was best and present it to the class.

Sessions 9 and 10 included an examination of the official early childhood education program that focuses on the philosophy of the program, play inclusion in the program, child developmental requirements as defined by the program, mathematics subjects covered in the program, and goals and behaviors for the mathematics subjects. For homework, the teacher candidates were asked to submit the mathematics goals and behaviors (as defined by the official program) included in their selected play activities. During sessions 11 and 12, the instructor explained how to detect moments that could be used for teaching during or after (free) play by presenting some examples. For sessions 13 and 14, the teacher candidates, individually, were asked to prepare and submit a lesson plan. Then, the group members came together again and discussed each member's plan and constructed a new one for teaching practice. All the groups (n=8) taught mathematics through plays. For the teaching phase, within each group, one was chosen by the group members to act as a teacher and the remaining members acted as helpers. Each group taught to the same group (n=16) during two lesson hours (80 minutes). Teaching sessions for the groups were arranged by the instructor. Each teacher candidate was also required submit answers to the second open-ended questionnaire. This questionnaire included questions on any difficulties that he/she experienced while preparing and teaching his/her play-generated lesson plan.

Data Analysis

The MTEBI presented by Enochs, Smith and Huinker (2000) contained two sub-sections: PMTE and MTOE. Therefore, the data analysis results focused first on the teacher candidates' personal mathematics teaching efficacy beliefs and their mathematic teaching outcome expectancies; then on the MTEBI as a whole, namely the teacher candidates' mathematics teaching efficacy beliefs. SPSS 17.0 was used in order to present the inferential statistics. A paired samples t-test was used in order to compare the pre and posttest scores within the same group in order to discover whether a score change occurred. In addition, the qualitative data collected through the open–ended questionnaire, and lesson plan observation forms were analyzed using open coding. All of the data was coded by the researcher and controlled by an external expert.

Internal Validity

Fraenkel and Wallen (2000) stated that, for one-group's pretest-posttest design, some "uncontrolled-for threats to internal validity exist that might also explain the results on the post-test" (p. 288). These threats and how they were coped with within the study are as follows: location, instrument decay, data collector characteristics, data collector bias, testing, statistical regression, attitude of subjects and implementation. These threats are discussed in more detail below.

- *Location was also minor problem in the one-group pretest-posttest design because the location where the treatment was administered was constant throughout the study.*
- *Instrument decay was a minor problem in the study as the instrument used in the study was used in earlier studies (most recently by Sahinkaya (2008).*
- *Data collector characteristics was controlled for in the study as the one-group pretest-posttest designs employed the same instructor for all of the participants, although such characteristics may be a design problem when using different collectors for different methods.*
- *Data collector bias did not occur as the treatment was administered and data collected as the researcher intended.*
- *Testing was a minor problem in this study as problems can occur when the participants respond to an instrument more than once (Fraenkel & Wallen, 2000).*
- *Statistical regression was not a problem in this study as participants were chosen using a convenience sample rather than selecting the subjects on a basis, such as extreme scores.*
- *Attitude of subject was controlled for in the current study as each participant received the same treatment.*

- *Implementation was controlled for the study as all of the subjects were instructed by the same instructor.*

Ethical Issues

In the study, no harm occurred to the teacher candidates. Each teacher candidate was provided with the same information during the treatment and participated in the study using assigned pseudonyms.

RESULTS

Inferential statistics for mathematics teaching efficacy beliefs

The MTEBI presented by Enochs, Smith and Huinker (2000) contains PMTE and MTOE subsections. Therefore, the results of the study first focused on the teacher candidates' personal mathematics teaching efficacy beliefs and their mathematic teaching outcome expectancies; then the results focused on the MTEBI as a whole, namely on the teacher candidates' mathematics teaching efficacy beliefs. As shown in Table 2, the paired sample t-test indicated a statistically reliable increase between the pre-test scores (M = 74.18, SD = 7.33) and post-test scores (M = 83.10, SD = 7.04) for the mathematics teaching efficacy beliefs [t (36) = -5.792, p = 0.000, α = 0.005]. The eta squared statistic (0.48) indicated a large effect size (Cohen, 1988). Rimm-Kaufman and Sawyer (2004) implied in their study that teacher candidates' positive attitudes towards the teaching approach, which was the play-generated curriculum approach in our case, may contribute to their teaching efficacy beliefs. Most teacher candidates provided their positive opinions about the play-generated curriculum approach with the statements of "Teaching through play-generated curriculum provided an environment of learning while entertaining..," "It [play-generated curriculum] can be applied to any mathematics subject," "I can see that they [students] were learning."

Table 3 shows that the paired samples t test results differed between the pre-test scores (M = 46.18, SD = 5.86) and post-test scores (M = 51.7, SD = 5.02) for the personal mathematics teaching efficacy beliefs. The difference was found to be statistically significant and showed an improvement in the beliefs [t (36) = -4.625, p = 0.000, α = 0.005]. The eta squared statistic (0.37) indicated a large effect size (Cohen, 1988), high enough to warrant practical significance. According to Bandura (1997), the most powerful influencing factor on a teacher's self-efficacy belief mastery is related with the actual teaching accomplishments with students. A general agreement that reached through observation of teacher candidates during their actual teaching that they, most of the time, accomplished their objectives during

Table 2. *Paired-Sample t-test results for mathematics teaching efficacy beliefs (MTEB)*

	t	*df*	*p*
MTEB	-5.792	36	0.000*

*$p < 0.005$

Table 3. *Paired-Sample t-test results for personal mathematics teaching efficacy (PMTE) beliefs*

	t	*df*	*p*
PMTE	-4.625	36	0.000*

*$p < 0.005$

Table 4. *Paired-Sample t-test results for mathematics teaching outcome expectancy (MTOE)*

	t	*df*	*p*
MTOE	-3.003	36	0.005*

*$p < 0.005$

the lesson. This sense of achievement may contribute to their self-efficacy beliefs in turn.

A significant improvement in the mathematics teaching outcome expectancy [t (36) = -3.003, p = 0.005, α = 0.005] was evident from the paired samples t-test between the pre-test scores (M = 28, SD = 5.68) and post-test scores (M = 31.4, SD = 3.67) of the teacher candidates (See Table 4). The eta squared statistic (0.2) indicated a large effect size (Cohen, 1988). Studies (e.g.) presents that outcome expectancy increases with actual teaching experience. However, studies (e.g. Denham, & Michael, 1981) also shows that novice teachers can be more confident of their students' achievement (outcome expectancy) than teachers with more experience who may hold the idea that efficacious and impacting student's achievement may not be limited to classroom instruction.

Descriptions of the qualitative data with regard to the teacher candidates' responses about the implementation of play-generated curriculum

An examination of the answers for the open-ended questionnaire revealed that the teacher candidates found the play-generated curriculum approach to be useful. One of the most claimed advantages of using this approach was that the children were eager to learn and had fun while doing it. One teacher candidate mentioned "since our play was a spontaneous play and the teacher's intervention was at a minimal level, [the] children really did have fun and did not want to stop playing." The other advantage of this approach were stated as the "teachers have a chance to see their clients' most natural personalities because of the nature of (free)

play, and students were found to be more eager to learn since they had all control of their play."

On the other hand, the teacher candidates encountered several difficulties while applying the play-generated curriculum approach, including controlling the classroom, teaching during the play and, detecting teachable moments while the kids were playing. One student mentioned that

The kids were really having fun since they were playing what they wanted; however, most of the time, they were too noisy, and some [of the] students did not wanted to be included in the same play with the others.

Another attributed difficulty of this approach was tracking of the students' progress during their free-play due to the size of the classroom, which was not large enough to accommodate all of the children. The most emphasized difficulty was detecting teaching moments during the play. One teacher candidate mentioned that "[w]e could not decide where and how to intervene [with the] students during their play, and, after the intervention, putting them back to work (play) was also difficult. They did not like to get interrupted while playing." This result was not unexpected since even experienced teachers experience difficulty during application of a new teaching method inside their teaching environments.

Observers notes on teacher candidates' teaching

Each group had a chance to teach their lesson plan for two lesson hours (80 minutes) to a class with 16 six-year old students. Their topic selection from mathematics included the learning areas of numbers (3 groups), algebra (2 groups), geometry (2 groups), and data and chance (1 group). In the learning area of numbers, one group aimed to teach counting by two's and three's; another group aimed to teach mathematical quantities of numbers by matching with the objects; and the other group aimed to teach what zero mean. The aim of the algebra lesson was to teach addition within 1-20, and subtraction within 1-9. Both geometry lessons focused on the basic geometric shapes and their properties. The group with data and chance lesson plan aimed to teach estimation.

The observers found teacher candidates' personality during their teaching good (grading 4 out 5). Most mentioned problem was the phase of the voice during teaching. "Sometimes, candidates spoke too loudly while sometimes too quite that caused distraction of the attention." Adaptation to the teaching environment was the second problem that attracted observers' attention. "Teachers usually could not decide how to intervene play to create a chance for teaching."

Teacher candidates' classroom management also found good (graded 4 out of 5). Observers noted that teachers' presentation of the topic was good enough to

achieve the goal of their lessons. However, in especially teaching of the algebra topics (addition and subtraction), teacher candidates' negligence of students' prior knowledge was mentioned by the observers. One observer stated *"Trying to teach addition within 20 and subtraction within 10 is not consistent with the official early childhood teaching program that requires adding within 10 and subtracting within 5."* Similarly, alignment with official curriculum was also found problematic in the lessons relating geometric shapes and number quantities.

For the actual teaching phase, teacher candidates overall grade was 3.5 between fair and good. As stated above, teacher candidates usually had hard time to decide teaching moments during free play activities. Play activities were found applicable to the intended objectives of the lessons while there were few issues about curriculum match. Students were eager and active during their learning. One observer stated that "since the lessons were based on the play activities, students' motivation, interest, and participation during the lessons was very good. They were having good time although they were sometimes out of control." Teacher candidates who try to teach estimation had the lowest grade (2) in this category. Although their estimation play was found acceptable by the observers, the teacher and the helpers found weak in implementation of the lesson plan. One observer said that *"providing a jar of 213 marbles and trying to make students estimate the number of marbles inside the jar was a mistake. The curriculum does not require from students to read, write, and even count until 200 so how can they make that big estimation?"*

Teacher candidates grade for objectives and methodology was fair (4). Their teaching methods were consistent with the play-generated curriculum approach; however, their application of the approach was not at the desired level. Objectives of the lessons were found in line with the official early childhood teaching program for 6-year olds. However, teacher candidates usually ignored to assess whether the lesson achieved the intended goal (measurement and evaluation).

DISCUSSIONS AND IMPLICATIONS

This study aimed to present the effects of play-generated curriculum instruction on early childhood teacher candidates' mathematics teaching efficacy beliefs by focusing on self-efficacy and the related outcome expectancy beliefs. This study is limited with that the teacher candidates had to present and teach their lesson plans and play activities in groups as the size of the class was too large to allow for individual presentations during the regular course hours. This might have had an effect on the results of the study.

One of the results of this study has indicated that early childhood teacher candidates' mathematics teaching efficacy beliefs underwent a positive change after the teacher candidates prepared play-based instruction and taught mathematics to young kids through play. Self-efficacy beliefs have a strong influence on an individual's achievement level (Pajares, 1996). Graham, Harris, Fink, and McArthur (2001) also indicated in their study that teachers' self-efficacy beliefs were positively correlated with their capabilities and their self-confidence as well as their students' academic achievements and motivations. In the current study, the qualitative data supported the quantitative data since teacher candidates had a good time during the instructions and during their teaching experiences.

The study also indicated that the play-generated instruction approach had a positive effect on the improvement of early childhood teacher candidates' personal mathematics teaching and outcome expectancy beliefs. One reason for the change could be that the experiment they received and the activities participated in during the course improved their efficacy beliefs as research has shown that that training in the pre-service period improves and strengthens teachers' self-efficacy beliefs (Ekici, 2008; Palmer, 2006; Woolfolk & Hoy, 1990). This result could be also attributed to students' beliefs and attitudes regarding the teaching of mathematics, which are firmly set prior to entry into teacher education programs as a result of their mathematics-related experiences in primary and high schools (Ginns & Watters, 1995). The foundation of these teacher candidates' beliefs and attitudes regarding the teaching of mathematics may have resided in their experiences prior to entry into their profession, proceeding the semester that they registered for the Play Development in Early Childhood course. Hence, immersion in the experiment, together with the teacher candidates' prior experiences, could possibly have had a significant impact on each individual's attitudes and beliefs.

The teacher candidates also found play-based instruction effective, useful and a good method by which to teach mathematics without boring or dictating to the children. Positive beliefs about the experiment might also have had a positive effect on improving the teacher candidates' mathematics teaching efficacy beliefs. On the other hand, the teacher candidates found it difficult to make decisions as to where to teach during the play activities. This result could be expected from teacher candidates since it is more challenging to seek out and use children's interests as the basis for play-generated curriculum than it is to select from them a play theme (Cuffaro, 1995). In-service teachers also experienced the problem of using free play as a medium of learning (Bennett, Wood, & Rogers, 1997).

This study may serve as a source for future researchers who wish to investigate the effects of play based-curriculum approaches on the mathematics teaching beliefs of in-service teachers who have had a

chance to apply this instruction in a real teaching environment. Further analysis on the correlation between teachers' self-efficacy, model implementation and their performance in supporting the learning of mathematics in young children would be very beneficial to the teaching profession. Additional research examining the reasons why teacher candidates have difficulty while using play-generated curriculum approach would be beneficial.

REFERENCES

Balfanz, R., Ginsburg, H. P., & Greenes, C. (2003). The big math for little kids: Early childhood mathematics programs. *Teaching Children Mathematics, 9*(5), 264-268.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Beauchat, K. A., Blamey, K. L. and Walpole, S. (2010). *The building blocks of preschool success.* The Guilford Press: New York.

Bennett, N., Wood, L., & Rogers, S. (1997). *Teaching through play: Teacher's thinking and classroom practice.* Buckingham, United Kingdom: Open University Press.

Berk, L.E. (1994). Vygotsky' s theory: The importance of make-believe play. *Young Children, 50*, 30- 39.

Bredekamp, S., & Copple, C. (Eds.) (1997). *Developmentally appropriate practice in early childhood programs.* Washington, DC: National Association for the Education of Young Children.

Cakiroglu, E. (2000). *Preservice elementary teachers' sense of efficacy in reform oriented mathematics.* Unpublished doctoral dissertation. Indiana University.

Can, B. T., Günhan, B. C., & Erdal, S. Ö. (2012). Using Mathematics in Teaching Science Self-efficacy Scale– UMSSS: A Validity and Reliability Study. *Eurasia Journal of Mathematics, Science & Technology Education, 8*(4), 269-281.

Cohen, J. W. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Cuffaro, H. (1995). *Experimenting with the world: John Dewey and early childhood classroom.* New York: Teachers College Press.

Denham, C. H., & Michael, J. J. (1981). Teacher sense of efficacy: A definition of the construct and a model for further research. *Educational Research Quarterly, 6*(1), 39 – 63.

Ekici, G. (2008). Sınıf yönetimi dersinin öğretmen adaylarının öğretmen öz-yeterlik algı düzeyine etkisi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 35*, 98-110.

Enochs, L. G., Smith, P. L., & Huinker, D. (2000). Establishing factorial validity of the mathematics teaching efficacy beliefs instrument. *School Science and Mathematics, 100* (4), 194-202.

Enz, B.J., & Christie, J.F. (1993). *Teacher play style interactions and their impact on children' s language and emergent literacy.* Paper presented at the National Reading Conference, Charleston, SC.

Finney, S. J., & Schraw, G. (2003). Self efiicacy beliefs in college statistics course. *Contemporary Educational Psychology, 28*, 161-186.

Fraenkel J. R., & Wallen N. E. (2000). *How to Design and Evaluate Research in Education.* McGraw-Hill Higher Education.

Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*(4), 569-582.

Ginns, I. S., & Watters, J. J. (1995). An analysis of scientific understanding of preservice elementary teacher education students. *Journal of Research in Science Teaching, 32*, 205-222.

Ginsburg, K. R. (2007). The importance of play in promoting healthy child development and maintaining strong parent-child bonds. *Pediatrics. 119 (1),* 182-91.

Graham, S., Harris, K. R., Fink, B., & McArthur, C. A. (2001). Teacher efficacy in writing: A construct validation with primary grade teachers. *Scientific Studies of Reading, 5*(2), 177-203.

Hanline, M. F. (1999). Developing a preschool play-based curriculum. *International Journal of Disability, Development and Education, 46(3)*, 289-305

Huinker, D., & Madison, S. K. (1997). Preparing efficacious elementary teachers in science and mathematics: The influence of methods courses. *Journal of Science Teacher Education, 8*(2), 107-126.

Isler, I., & Cakiroglu, E. (2009). Teachers' efficacy beliefs and perceptions regarding the implementation of new primary mathematics curriculum. *Proceedings of CERME 6*, 1704-1713, Lyon France

Johnson, B., & Christensen, L. (2004). *Educational research.* Pearson education, Inc.

Johnson, J. E., Christie, J. F., & Yawkey, T.D. (1999).*Play and early childhood development.*(2nd ed.). New York: Longman.

Kagan, S. L., & Cohen. N. E. (1997). *Not by Chance. Creating an Early Childhood and Education System for America's Children.* New Haven, CT: Yale University Press.

Kirova, A., & Bhargava, A. (2002). Learning to guide preschool children's mathematical Understanding: A teacher's professional growth. *Early Childhood Research and Practice, 4 (1)*, 1-19.

Levy, A., Wolfgang, C., & Koorland, M. A. (1992). Sociodramatic play as a method for enhancing the language performance of kindergarten age students. *Early Childhood Research Quarterly, 7*, 245- 263.

Mallory, B. L., & New, R. S. (1994). Social constructivist theory and principles of inclusion: Challenges for early childhood special education. *Journal of Special Education, 28*, 322-337.

Mayesky, M. (2002). *Creative Activities for Young Children,* (7th ed). Albany, NY: Delmar Thompson Learning.

National Association for the Education of Young Children. (2008). *Early childhood mathematics: Promoting good beginnings. A joint position statement of the National Association for the Education of Young Children (NAEYC) and the National Council for Teachers of Mathematics (NCTM).* Washington, DC: NAEYC.

National Council for Teachers of Mathematics. (2006). *Curriculum focal points for prekindergarten through grade 8 mathematics: A quest for coherence.* Reston, VA: National Council for Teachers of Mathematics, Inc.

Pajares, F. M. (1996). Self-efficacy beliefs and mathematical problem-solving of gifted students. *Contemporary Educational Psychology*, *21*, 325-344.

Palmer, D. H. (2006). Sources of self-efficacy in a science methods course for primary teacher education students. *Research in Science Education*, 36, 337-353.

Pound, L. (2008). *Thinking and Learning about Mathematics in the Early Years*. Abingdon, UK: Routledge.

Riggs, M. I., & Enochs, L. G. (1990). Toward the development of elementary teacher's Science Teaching Efficacy Belief Instrument. *Science Education*, *74*(6), 625-637.

Rimm-Kaufman, S. E., & Sawyer, B. E. (2004). Primary-grade teachers' self-efficacy beliefs, attitudes toward teaching, and discipline and teaching practice priorities in relation to the "responsive classroom" approach. *The Elementary School Journal*, 104(4), 321-341.

Sahinkaya, N. (2008). *Türkiye-Finlandiya sınıf öğretmenliği mateamatik öğretimi programları, sınıf öğretmeni adayları ile öğretmenlerin öz-yetkinlik ve öğrenme- öğretme süreçleri açısından karşılaştırılması* (Unpublished doctoral dissertation). Gazi University, Ankara.

Swars, S. L. (2004). *Mathematics teaching efficacy beliefs of elementary preservice teachers and their relationship to mathematics anxiety*. Unpublished doctoral dissertation, University of Alabama.

Swars, S. L., Daane, C. J., & Giesen, J. (2006). Mathematics anxiety and mathematics teacher efficacy: What is the relationship in elementary preservice teachers? *School Science and Mathematics, 106*(7), 306-315.

Swars, S. L., Smith, S. Z., Smith, M. E., & Hart, L. C. (2009). A longitudinal study of effects of a developmental teacher preparation program on elementary prospective teachers' mathematics beliefs. *Journal of Mathematics Teacher Education, 12*(1), 47-66.

Thomson, M. M., & Kaufmann, E. (2013). Elementary Teachers' Views of their Science Professional Development Attendance: An Expectancy-Value Approach. *Eurasia Journal of Mathematics, Science & Technology Education*, *9*(1), 45-58.

Trawick-Smith, J. (1998). Why play training works: An integrated model for play intervention. *Journal of Research in Childhood Education*, *12*, 117-129.

Van Hoorn, J., Nourot, P., Scales, B., & Alward, K. (1993). *Play at the center of the curriculum*. New York: Macmillan

Vukelich, C. (1994). Effects of play intervention on young children' s reading of environmental print. *Early Childhood Research Quarterly*, *9*, 153-170.

Wenta, R. G. (2000). *Efficacy of preservice elementary mathematics teachers*. Unpublished doctoral dissertation, Indiana University.

Wheatley, K. F. (2005). The case for reconceptualizing teacher efficacy research. *Teaching and Teacher Education*, *21,* 747-766.

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control. *Journal of Educational Psychology*, *82*(1), 81-91.

Zengin, K. U. (2003). *İlköğretim öğretmenlerinin öz-yeterlik algıları ve sınıf-içi iletişim örüntüleri*. Published Master's Thesis. İzmir: Dokuz Eylül University.

❖ ❖ ❖